CLAIMS

1. A polishing pad for planarizing microelectronic-device substrate assemblies, comprising:

a backing member having a first surface and a second surface;

a plurality of pattern elements distributed over the first surface of the backing member, the pattern elements defining a plurality of contour surfaces projecting away from the first surface of the backing member; and

a hard cover layer over the pattern elements and over portions of the first surface of the backing member exposed between pattern elements, the cover layer at least substantially conforming to the contour surfaces of the pattern elements to form a plurality of hard nodules projecting away from the first surface of the backing member, the nodules defining at least a portion of a planarizing surface of the polishing pad for engaging a microelectronic-device substrate assembly.

2. The polishing pad of claim 1 wherein the pattern elements comprise particles distributed over the backing member.

3. The polishing pad of claim 2 wherein the particles comprise at least one of silica particles or particles composed of organic polymers.

4. The polishing pad of claim 3 wherein the organic polymer is latex.

5. The polishing pad of claim 3 wherein the particles have particle sizes from approximately 0.01 to 0.5 μm.

6. The polishing pad of claim 3 wherein the particles have particle sizes from approximately 0.01 to 0.12 μm.

7. The polishing pad of claim 3 wherein the particles have a spherical shape.

8. The polishing pad of claim 1 wherein the pattern elements comprise nonabrasive particles.

9. The polishing pad of claim 1 wherein the pattern elements comprise particles distributed over the backing member with a surface density from approximately 100 particles/mm^2 to 1×10^8 particles/mm^2.

10. The polishing pad of claim 1 wherein the cover layer comprises an abrasive layer of material deposited over the pattern elements.

11. The polishing pad of claim 9 wherein the abrasive layer comprises at least one of silicon nitride, ceria, silica, alumina, zirconia, titanium or titanium nitride.

12. The polishing pad of claim 1 wherein the pattern elements are distributed directly on the first surface of the backing member.

13. The polishing pad of claim 1, further comprising an intermediate layer having a lower surface directly on the first surface of the backing member and an upper surface over the first surface of the backing member, the pattern elements being distributed directly on the upper surface of the intermediate layer.

14. The polishing pad of claim 13 wherein the intermediate layer comprises at least one of a metal material or a ceramic material.

15. The polishing pad of claim 14 wherein the pattern elements comprise at least one of silica particles or latex particles distributed on the upper surface of the intermediate layer.

16. The polishing pad of claim 15 wherein the particles have particle sizes from approximately 0.01 to 0.5 µm.

17. The polishing pad of claim 15 wherein the particles have particle sizes from approximately 0.01 to 0.12 µm.

18. The polishing pad of claim 14 wherein the pattern elements comprise nonabrasive particles.

19. The polishing pad of claim 14 wherein the pattern elements comprise particles distributed over the backing member with a surface density from approximately 100 particles/mm^2 to 1×10^8 particles/mm^2.

20. The polishing pad of claim 14 wherein the cover layer comprises an abrasive layer of material deposited over the pattern elements.

21. The polishing pad of claim 20 wherein the abrasive layer comprises at least one of silicon nitride, ceria, silica, alumina, zirconia, titanium or titanium nitride.

22. The polishing pad of claim 21 wherein a plurality of surface grooves having a depth through the cover layer, the intermediate layer and a portion of the backing member extend across the planarizing surface to allow the polishing pad to be wrapped around a roller of a web format planarizing machine.

23. The polishing pad of claim 21 wherein a plurality of surface grooves having a depth through the cover layer, the intermediate layer and a portion of the backing member extended across the planarizing surface to transport planarizing solution under the substrate assembly.

24. The polishing pad of claim 1 wherein the backing member comprises a polymeric material.

25. The polishing pad of claim 1 wherein the backing member comprises a polyurethane body.

26. The polishing pad of claim 1 wherein the backing member comprises mylar.

27. A polishing pad for planarizing microelectronic-device substrate assemblies, comprising:

a base section having a first surface, a plurality of contour surfaces above the first surface, and a second surface configured to be placed over a support table of a planarizing machine; and

a plurality of abrasive elements projecting away from the base section to define at least a portion of a planarizing surface for engaging a microelectronic-device substrate assembly, the abrasive elements including raised portions of a hard cover layer over the contour surfaces that project away from the base section.

28. The polishing pad of claim 27 wherein:

the base section comprises a backing member and a plurality of pattern elements distributed over the backing member, each pattern element having a portion projecting away from the backing member, the portions of the pattern elements projecting away from the backing member defining the contour surfaces; and

the cover layer at least substantially conforms to the contour surfaces of the pattern elements to form hard nodules defining the abrasive elements.

29. The polishing pad of claim 28 wherein the pattern elements comprise particles distributed directly on the backing member.

30. The polishing pad of claim 28 wherein the pattern elements comprise particles having particle sizes from approximately 0.01 μm to 0.12 μm.

31. The polishing pad of claim 28, further comprising an intermediate layer directly on the backing member, and wherein the pattern elements comprise particles distributed directly on the intermediate layer over the backing member.

32. The polishing pad of claim 31 wherein the intermediate layer comprises at least one of a metal material or a ceramic material.

33. The polishing pad of claim 28 wherein the cover layer comprises an abrasive material.

34. The polishing pad of claim 33 wherein the abrasive layer comprises at least one of silicon nitride, ceria, silica, alumina, zirconia, titanium or titanium nitride.

35. The polishing pad of claim 28, further comprising an intermediate layer directly on the backing member, the pattern elements comprise particles having particle sizes from 0.01 to 0.12 μm distributed directly on the intermediate layer over the backing member, and the cover layer comprises an abrasive material over the pattern elements.

36. A planarizing machine for planarizing microelectronic-device substrate assemblies, comprising:

a table;

a carrier assembly having a substrate holder positionable over the table; and

a polishing pad on the table, the polishing pad including a backing member having a first surface and a second surface, a plurality of pattern elements distributed over the first surface of the backing member to define a plurality of contour surfaces projecting away from the first surface of the backing member, and a hard cover layer over the pattern elements and over portions of the first surface of the backing member exposed between pattern elements, the cover layer at least substantially conforming to the contour surfaces of the pattern elements to form a plurality of hard nodules projecting away from the first surface of the backing member, the nodules defining at least a portion of a planarizing surface of the polishing pad for engaging a microelectronic-device substrate assembly held by the substrate holder.

37. The planarizing machine of claim 36 wherein the pattern elements comprise particles distributed over the backing member.

38. The planarizing machine of claim 36 wherein the particles have particle sizes from approximately 0.01 to 0.12 μm.

39. The planarizing machine of claim 36 wherein the cover layer comprises an abrasive layer of material deposited over the pattern elements.

40. The planarizing machine of claim 39 wherein the abrasive layer comprises at least one of silicon nitride, ceria, silica, alumina, zirconia, titanium or titanium nitride.

41. The planarizing machine of claim 36, further comprising an intermediate layer having a lower surface directly on the first surface of the backing member and an upper surface over the first surface of the backing member, the pattern elements being distributed directly on the upper surface of the intermediate layer.

42. The planarizing machine of claim 41 wherein the intermediate layer comprises at least one of a metal material or a ceramic material.

43. The planarizing machine of claim 42 wherein the particles have particle sizes from approximately 0.01 to 0.12 μm.

44. The planarizing machine of claim 42 wherein the cover layer comprises an abrasive layer of material deposited over the pattern elements.

45. The planarizing machine of claim 44 wherein the abrasive layer comprises at least one of silicon nitride, ceria, silica, alumina, zirconia, titanium or titanium nitride.

46. A planarizing machine for planarizing microelectronic-device substrate assemblies, comprising:

a table;

a carrier assembly having a substrate holder positionable over the table; and

a polishing pad on the table, the polishing pad including a base section having a first surface, a plurality of contour surfaces above the first surface, and a second surface configured to be placed over a support table of a planarizing machine, and the polishing pad further including a plurality of abrasive elements projecting away from the base section to define at least a portion of a planarizing surface for engaging a microelectronic-device substrate assembly held by the substrate holder, the

abrasive elements including raised portions of a hard cover layer over the contour surfaces that project away from the base section.

47. The planarizing machine of claim 46 wherein:

the base section comprises a backing member and a plurality of pattern elements distributed over the backing member, each pattern element having a portion projecting away from the backing member, the portions of the pattern elements projecting away from the backing member defining the contour surfaces; and

the cover layer at least substantially conforms to the contour surfaces of the pattern elements to form hard nodules defining the abrasive elements.

48. The planarizing machine of claim 47 wherein the pattern elements comprise particles distributed directly on the backing member.

49. The planarizing machine of claim 47 wherein the pattern elements comprise particles having particle sizes from approximately 0.01 μm to 0.12 μm.

50. The planarizing machine of claim 47, further comprising an intermediate layer directly on the backing member, and wherein the pattern elements comprise particles distributed directly on the intermediate layer over the backing member.

51. The planarizing machine of claim 50 wherein the intermediate layer comprises at least one of a metal material or a ceramic material.

52. The planarizing machine of claim 47 wherein the cover layer comprises an abrasive material.

53. The planarizing machine of claim 52 wherein the abrasive layer comprises at least one of silicon nitride, ceria, silica, alumina, zirconia, titanium or titanium nitride.

54. The planarizing machine of claim 47, further comprising an intermediate layer directly on the backing member, the pattern elements comprise particles having particle sizes from 0.01 to 0.12 μm distributed directly on the intermediate layer over the backing member, and the cover layer comprises an abrasive material over the pattern elements.

55. A method of manufacturing a polishing pad for planarization of a microelectronic-device substrate assembly, comprising:

forming a plurality of contour surfaces over a first surface of a backing member to project away from the first surface; and

covering the contour surfaces with a cover layer of hard material that conforms to the contour surfaces to form nodules from the portions of the hard cover layer over the contour surfaces, the nodules projecting away from the first surface of the backing member.

56. The method of claim 55 wherein forming a plurality of contour surfaces comprises depositing a plurality of pattern elements over the first surface of the backing member, each pattern element having a portion projecting away from the first surface of the backing member, and the portions of the pattern elements projecting away from the backing member defining the contour surfaces.

57. The method of claim 56 wherein depositing a plurality of pattern elements over the first surface comprises coating the first surface with a liquid containing the pattern elements and evaporating the liquid to leave the pattern elements directly on the first surface of the backing member.

58. The method of claim 57 wherein coating the first surface with the liquid containing the pattern elements comprises drawing the backing member through a bath including the liquid and the pattern elements.

59. The method of claim 57 wherein coating the first surface with the liquid containing the pattern elements comprises spraying the first surface of the backing member with a solution including the liquid and the pattern elements.

60. The method of claim 56, further comprising constructing an intermediate layer directly on the first surface of the backing member, the pattern elements being distributed directly on the intermediate layer.

61. The method of claim 60 wherein constructing the intermediate layer comprises depositing at least one of a metal material or a ceramic material directly on the first surface of the backing member.

62. The method of claim 60 wherein depositing a plurality of pattern elements over the first surface comprises coating the intermediate layer with a liquid containing the pattern elements and evaporating the liquid to leave the pattern elements directly on the intermediate layer.

63. The method of claim 62 wherein coating the intermediate layer with the liquid containing the pattern elements comprises drawing the backing member and the intermediate layer through a bath including the liquid and the pattern elements.

64. The method of claim 62 wherein coating the intermediate layer with the liquid containing the pattern elements comprises spraying the intermediate layer with a solution including the liquid and the pattern elements.

65. The method of claim 55 wherein covering the contour surface with the cover layer comprises depositing the cover layer over the contour surfaces so that the cover layer at least substantially conforms to the contour surface.

66. The method of claim 65 wherein depositing the cover layer comprises chemical vapor deposition of either silicon nitride, ceria, silica, alumina, zirconia, titanium or titanium nitride.

67. The method of claim 65 wherein depositing the cover layer comprises plasma vapor deposition of either silicon nitride, ceria, silica, alumina, zirconia, titanium or titanium nitride.

68. The method of claim 55 wherein:

forming a plurality of contour surfaces comprises depositing a plurality of pattern elements over the first surface of the backing member, each pattern element having a portion projecting away from the first surface of the backing member, and the portions of the pattern elements projecting away from the backing member defining the contour surfaces; and

covering the contour surface with the cover layer comprises depositing the cover layer over the contour surfaces so that the cover layer at least substantially conforms to the contour surface, the cover layer being formed from either silicon nitride, ceria, silica, alumina, zirconia, titanium or titanium nitride.

69. A method of manufacturing a polishing pad for planarization of a microelectronic-device substrate assembly, comprising:

distributing a plurality of pattern elements over a first surface of a backing member, the pattern elements defining a plurality of contour surfaces projecting away from the first surface of the backing member; and

forming a layer of a hard material at least on the pattern elements to conform to the contour surfaces, the portions of the cover layer over the contour

surfaces projecting away from the first surface of the backing member to define abrasive nodules.

70. The method of claim 69 wherein distributing a plurality of pattern elements over the first surface comprises coating the first surface with a liquid containing the pattern elements and evaporating the liquid to leave the pattern elements directly on the first surface of the backing member.

71. The method of claim 70 wherein coating the first surface with the liquid containing the pattern elements comprises drawing the backing member through a bath including the liquid and the pattern elements.

72. The method of claim 70 wherein coating the first surface with the liquid containing the pattern elements comprises spraying the first surface of the backing member with a solution including the liquid and the pattern elements.

73. The method of claim 69, further comprising constructing an intermediate layer directly on the first surface of the backing member, the pattern elements being distributed directly on the intermediate layer.

74. The method of claim 73 wherein constructing the intermediate layer comprises depositing at least one of a metal material or a ceramic material directly on the first surface of the backing member.

75. The method of claim 73 wherein distributing a plurality of pattern elements over the first surface comprises coating the intermediate layer with a liquid containing the pattern elements and evaporating the liquid to leave the pattern elements directly on the intermediate layer.

76. The method of claim 75 wherein coating the intermediate layer with the liquid containing the pattern elements comprises drawing the backing member and the intermediate layer through a bath including the liquid and the pattern elements.

77. The method of claim 75 wherein coating the intermediate layer with the liquid containing the pattern elements comprises spraying the intermediate layer with a solution including the liquid and the pattern elements.

78. The method of claim 69 wherein forming the layer of hard material comprises chemical vapor deposition of either silicon nitride, ceria, silica, alumina, zirconia, titanium or titanium nitride.

79. The method of claim 78 wherein forming the layer of hard material comprises plasma vapor deposition of either silicon nitride, ceria, silica, alumina, zirconia, titanium or titanium nitride.

80. A method of planarizing a microelectronic-device substrate assembly, comprising:

pressing a surface of the substrate assembly against a polishing pad including a backing member having a first surface and a second surface, a plurality of pattern elements distributed over the first surface of the backing member to define a plurality of contour surfaces projecting away from the first surface of the backing member, and a hard cover layer over the pattern elements and over portions of the first surface of the backing member exposed between pattern elements, the cover layer at least substantially conforming to the contour surfaces of the pattern elements to form a plurality of hard nodules projecting away from the first surface of the backing member, the nodules defining at least a portion of a planarizing surface of the polishing pad for engaging a microelectronic-device substrate assembly held by a substrate holder; and

moving at least one of the substrate assembly or the polishing pad to translate the surface of the substrate assembly across at least a portion of the hard nodules.

81. A method of planarizing a microelectronic-device substrate assembly, comprising:

pressing a surface of the substrate assembly against a polishing pad including a base section having a first surface, a plurality of contour surfaces above the first surface, and a second surface configured to be placed over a support table of a planarizing machine, and the polishing pad further including a plurality of abrasive elements projecting away from the base section to define at least a portion of a planarizing surface for engaging a microelectronic-device substrate assembly held by a substrate holder, the abrasive elements including raised portions of a hard cover layer over the contour surfaces that project away from the base section; and

moving at least one of the substrate assembly or the polishing pad to translate the surface of the substrate assembly across at least a portion of the abrasive elements.

82. A polishing pad manufactured according to a method comprising:

forming a plurality of contour surfaces over a first surface of a backing member to project away from the first surface; and

covering the contour surfaces with a cover layer of hard material that at least substantially conforms to the contour surfaces and to portions of the first surface of the backing member exposed between pattern elements to form nodules from the portions of the hard cover layer over the contour surfaces, the nodules projecting away from the first surface of the backing member.

83. A polishing pad manufactured according to a method, comprising:

distributing a plurality of pattern elements over a first surface of a backing member, the pattern elements defining a plurality of contour surfaces projecting away from the first surface of the backing member; and

forming a layer of a hard material on at least the pattern elements to at least substantially conform to the contour surfaces, the portions of the cover layer over the contour surfaces projecting away from the first surface of the backing member to define abrasive nodules.